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硕 士 学 位 论 文

轧辊在线非接触检测系统的研究和设计

**Research and Design of On-line Non-contact Roll Profile
Measurement System**

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摘要

随着制造业的不断发展，汽车、家电等行业对金属薄板的需求日益增加。金属薄板的质量直接影响产品的性能、品质和外观。金属薄板是由一对或一组轧辊滚动时产生的压力来轧制而成，因此轧辊的辊型精度直接影响金属薄板的加工质量。轧辊磨床在线测量（On-line Profile Measurement，简称 OPM）是指磨床在磨制轧辊的过程中，对轧辊表面精度进行测量，并将测量数据反馈给轧辊磨床。轧辊磨床可以根据反馈的测量数据，对磨制中的轧辊进行准确的在线辊型磨削量控制，对提高辊型的加工质量和避免废件产生起到关键作用。

本论文分析了目前轧辊加工企业使用的轧辊辊型检测方式，主要以在线接触式测量为主。该测量方法虽拥有测量精度高、成本低的优点，但会在轧辊表面留下测量划痕影响轧辊的辊型精度，甚至造成轧辊废品产生。目前的非接触检测方式的研究核心为传感器的设计，比如超声波检测法、光纤检测法、CCD 检测法和激光检测法，然而这些检测方法都存在不同程度的缺点，如易于受环境干扰、测量结果不稳定、结构和操作复杂、成本高等，不利于检测装置的推广使用。此外，如果单独使用高精度的非接触传感器测量轧辊辊型，虽然可以保证测量精度高的优点，但由于传感器测量范围有限而被限制应用于凹凸量较大的曲辊辊型检测中。

针对非接触传感器测量范围窄的缺点，本论文提出“非接触传感器+滚珠丝杆+光栅尺”检测机构与恒间距检测原理结合的方式测量轧辊辊型。通过标定试验和偏心轮实验，验证了检测系统的性能。实验结果表明：当使用线性度为 $\pm 0.5\%F.S$ 的位移传感器时，轧辊在线检测系统的线性度可达到 $\pm 0.07\%F.S$ ；经多次测量，当标定平台在 35mm 的线性范围内移动时，轧辊在线检测系统的测量误差在 $\pm 25\mu m$ 之内；此外，根据实验可以证明，轧辊在线非接触检测系统可跟随被测物自动调整传感器的位置，验证了恒间距检测原理的可行性。

本论文提出轧辊在线非接触检测系统实现了在线非接触式测量、测量范围广、测量精度高、灵敏度高、非接触的特点，具有较好的开发实用前景。

关键字：轧辊辊型 在线非接触检测

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Abstract

With the continuous development of manufacturing industry, automobile, home electrical appliances industry, metal sheet demand is increasing. The quality of the sheet metal directly affects the product's performance, quality and appearance. Metal sheet is rolled by a group of roll, so the precision of roll profile directly influence the quality of sheet metal.

On-line Profile Measurement means measure roll profile in the process of grinding roll grinder, and the Measurement data feedback to roll grinding machine. Roll grinding machine can control the grinding quality for roll according to the feedback data. It is very important to improve the processing quality of roll or avoid waste.

This paper analyzes the roller testing way used by roll processing enterprise at present. Most of roll processing enterprise are using online contacting measurement. Though the measurement method has high accuracy, low cost advantages, but it will be left scratches on the roller profile and influence the precision of roller, even cause waste produce.

The core of current non-contact measurement methods hold attention on the research of the sensor, such as ultrasonic test method, optical fiber test method, test method of CCD and laser test. However these test methods exist different level shortcomings, such as easy to suffer environmental interference, measurement results instability, structure and operation complex , high cost, are not conducive to promote the use of these detection device. In addition, if using the high accuracy non-contact sensor measuring roller profile alone, though it can guarantee the advantage of high measurement precision, but because sensors measuring range is limited and be limited application in large quantities of convex roller profile testing.

According to the limited measuring range of contact sensor, this paper use the measurement way with combination of "non-contact sensor + ball screw + optical

grating scale" detection institutions and constant distance measuring principle. Through the calibration test and eccentric wheel experiments show online non-contact detection performance of the measurement system. The experimental results show that: when using displacement sensor with linear degrees of $\pm 0.5\%F.S$, the linearity of measurement system can achieve $\pm 0.07\%F.S$; After repeated measurement, in 35 mm when calibration platform mobile within 35mm, measurement system has measurement error within $\pm 25\mu m$; In addition, according to the experiment, it is can be proven, measurement system can be measured with things and adjust the sensor position automatically which verified the feasibility of constant detection principle.

This paper presents the measurement principle of constant distance measuring principle and roll profile online non-contact measurement system realize the online non-contact measurement, long measuring range, high accuracy, high sensitivity which prove that the measurement system has a good development practical prospect.

Keyword: Roll Profile; Online Non-contact Measurement

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